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(71) Applicant
Robert Michael Sloma
26 Freston Gardens, Cockfosters, Hertfordshire,
EN4 9CX, United Kingdom

(72) Inventor
Robert Michael Sloma

(74) Agent and/or Address for Service
E Eder & Co
39 Cranbrook Road, Ilford, Es
United Kingdom

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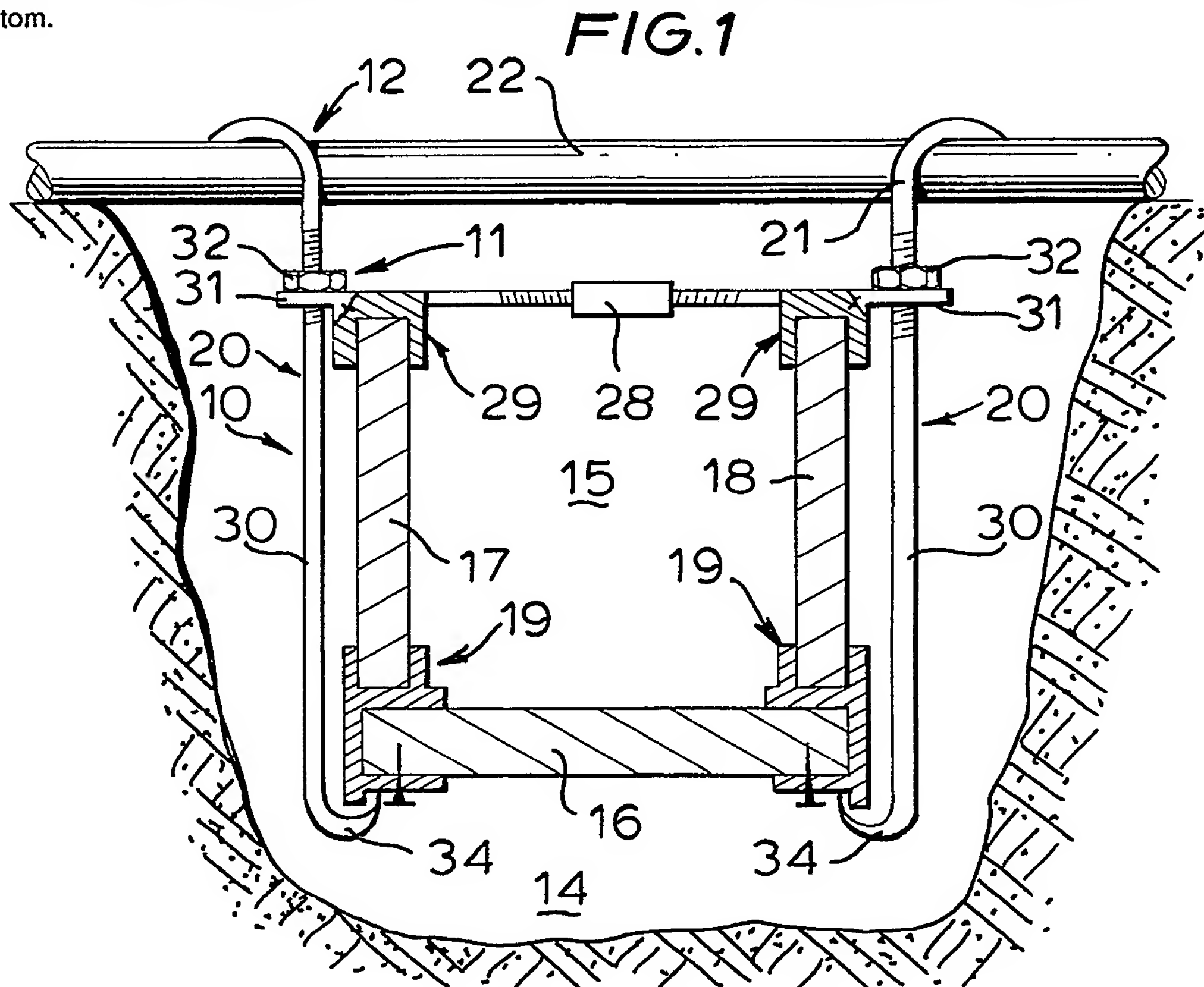
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GB 1080962 A GB 0914317 A GB 0820326 A

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UK CL (Edition K) **E1S**
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(54) Formwork apparatus

(57) Formwork apparatus for the casting of a beam comprises a first formwork panel (16) to provide a bottom support for the beam during casting, re-usable second and third formwork panels (17, 18) to provide lateral supports for the beam during casting, and readily releasable compression imparting means (20) having a first, operable condition in which they serve to apply compressive forces between the first panel (16) and the bottom edges of the second and third panels (17, 18), such that said panels (16-18) may form a self-supporting open-topped box, and a second, inoperable condition, in which such compressive forces are released to permit removal of the second and third panels (17, 18) – when the cast beam has set – and their subsequent re-use. The means (20) are used to suspend the framework in a trench above the trench bottom.



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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FIG. 1

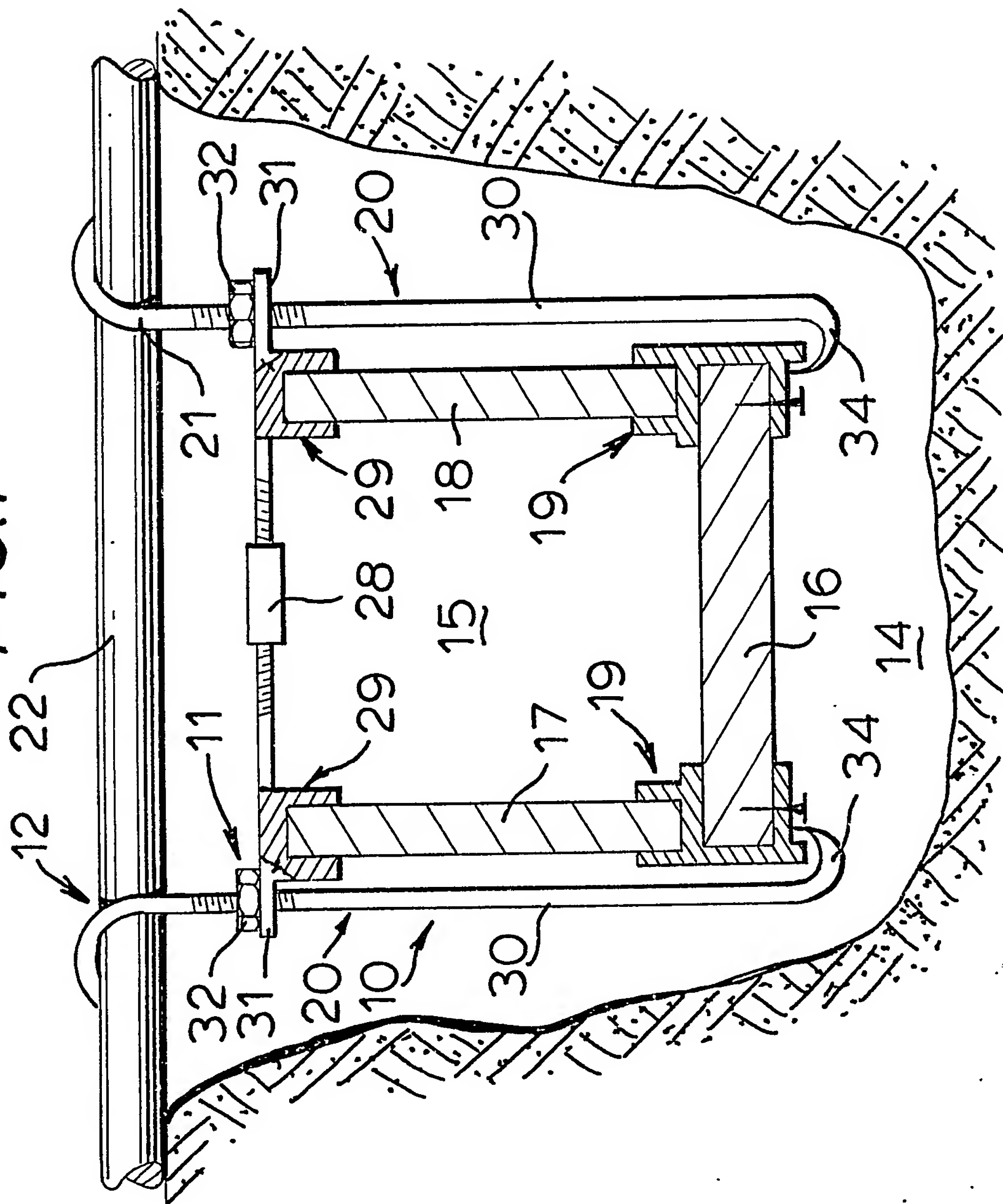


FIG.3

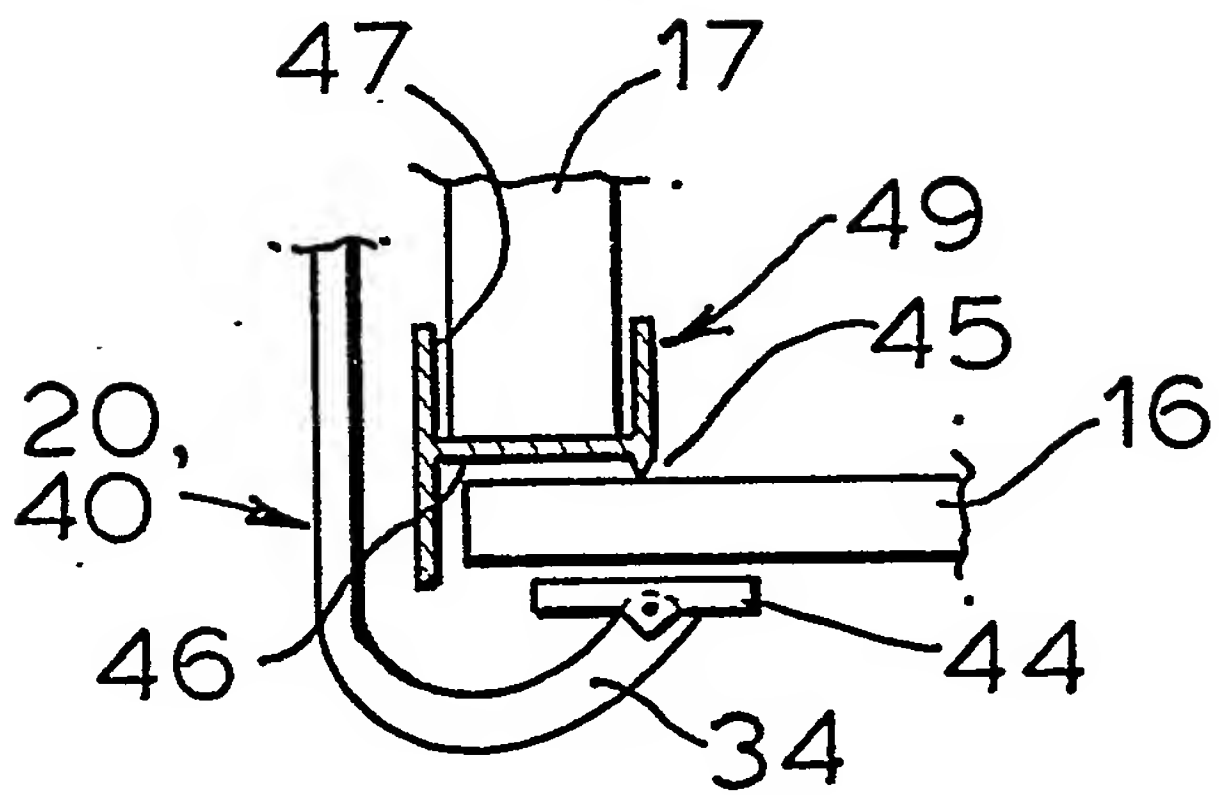


FIG.2

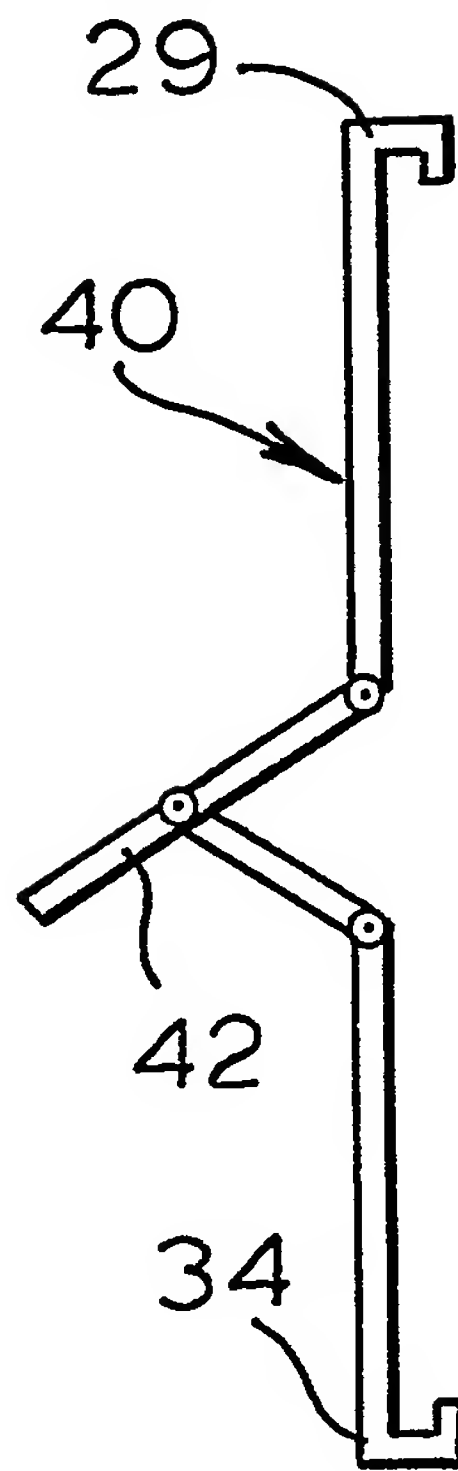


FIG.1a

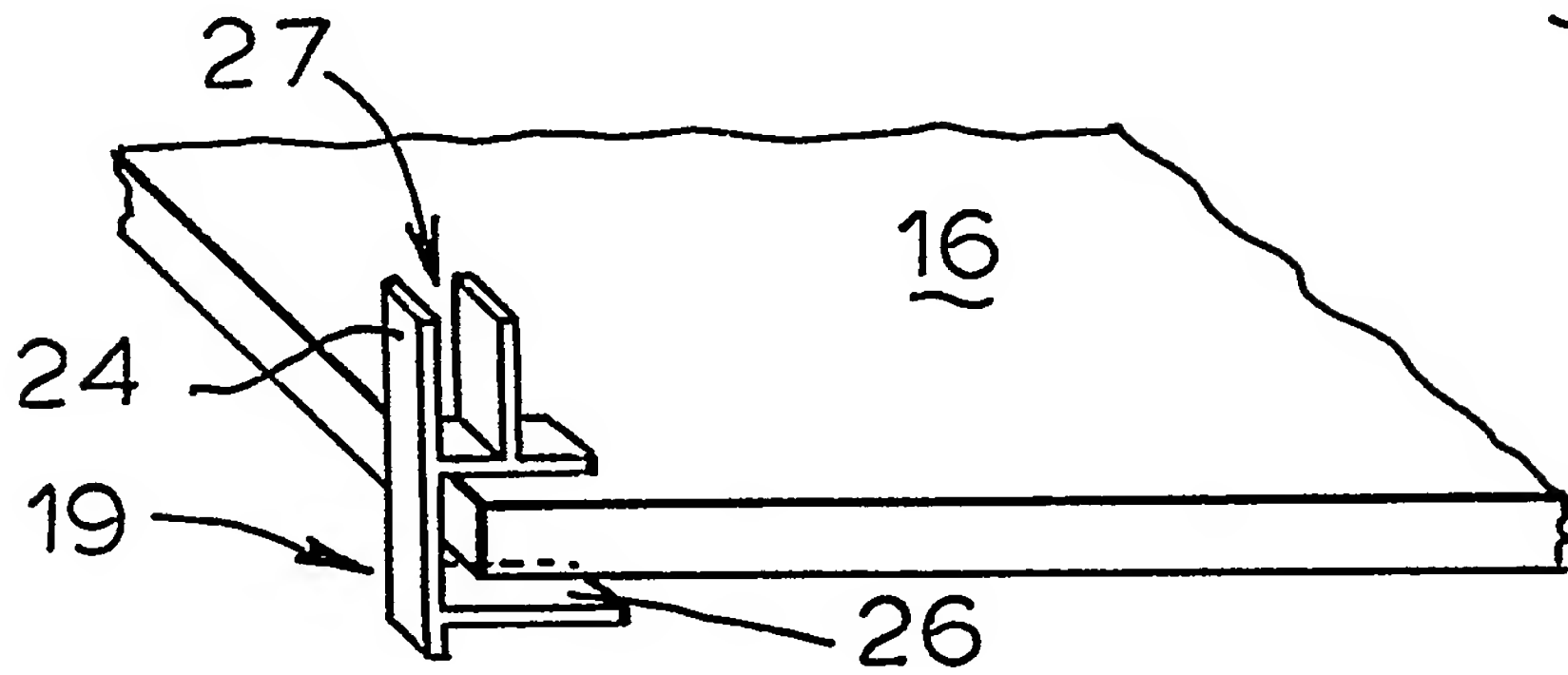


FIG.10

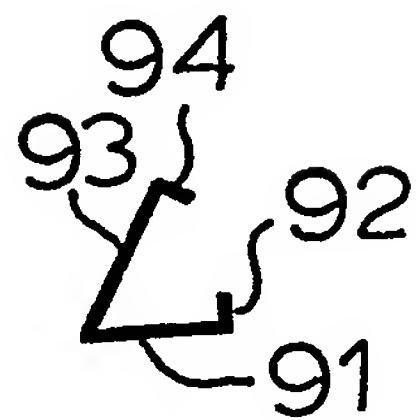


FIG.7

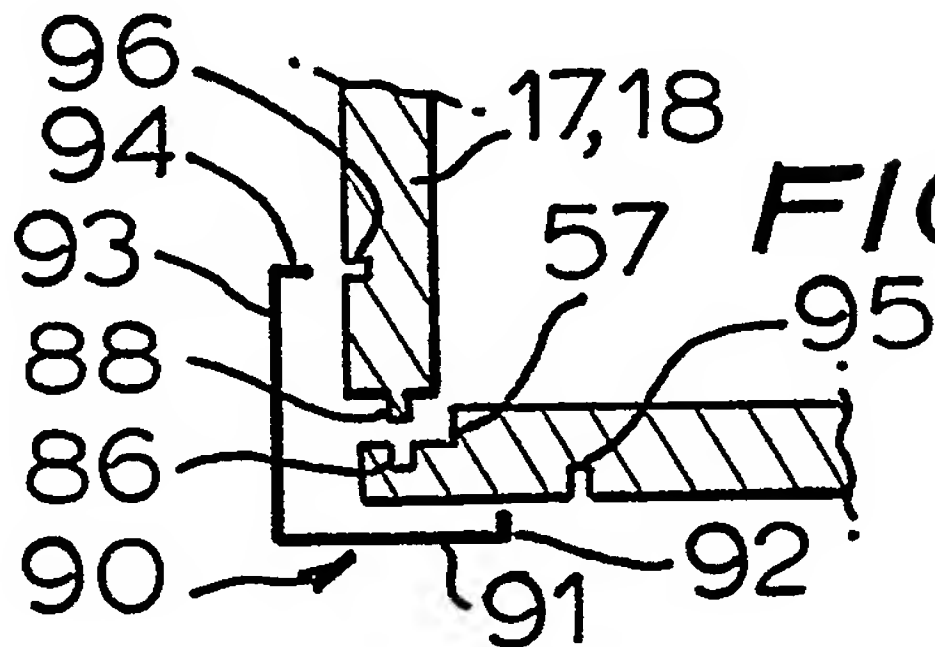
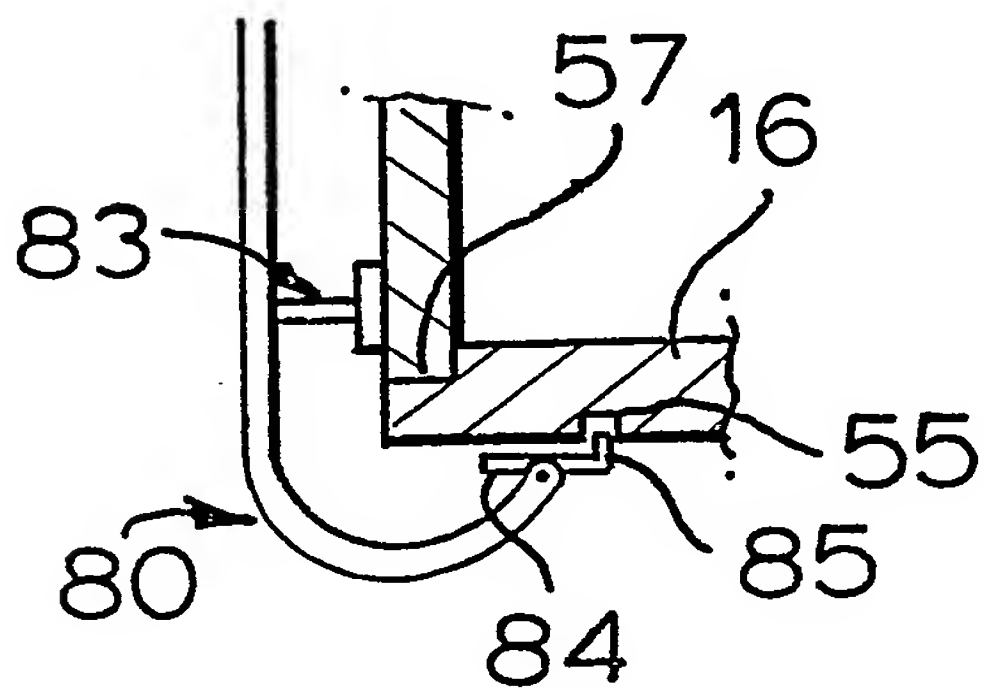
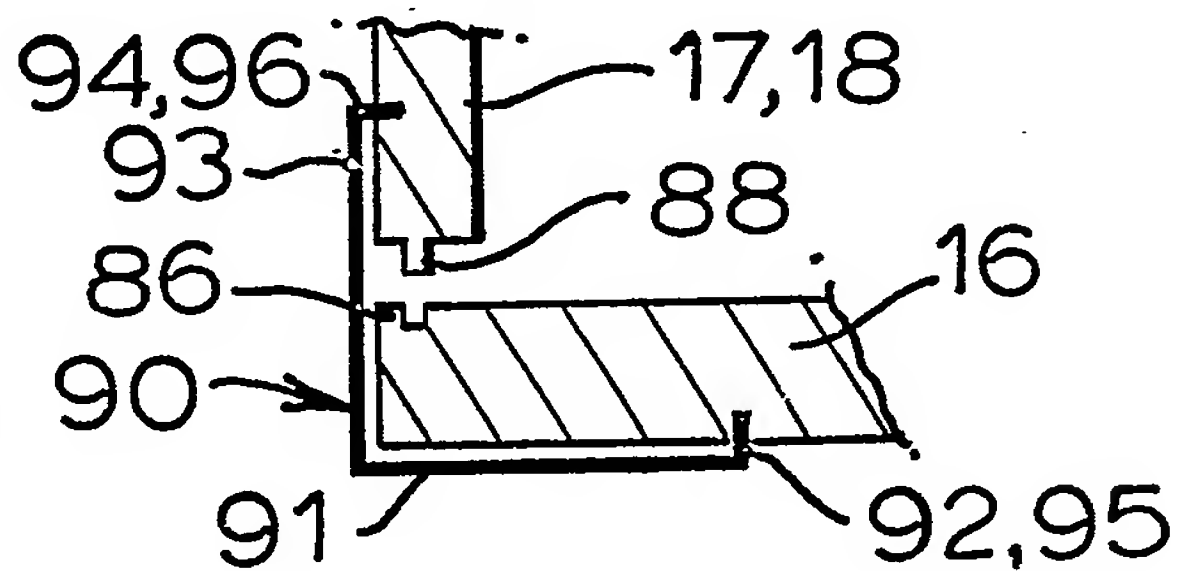


FIG.8

FIG.9



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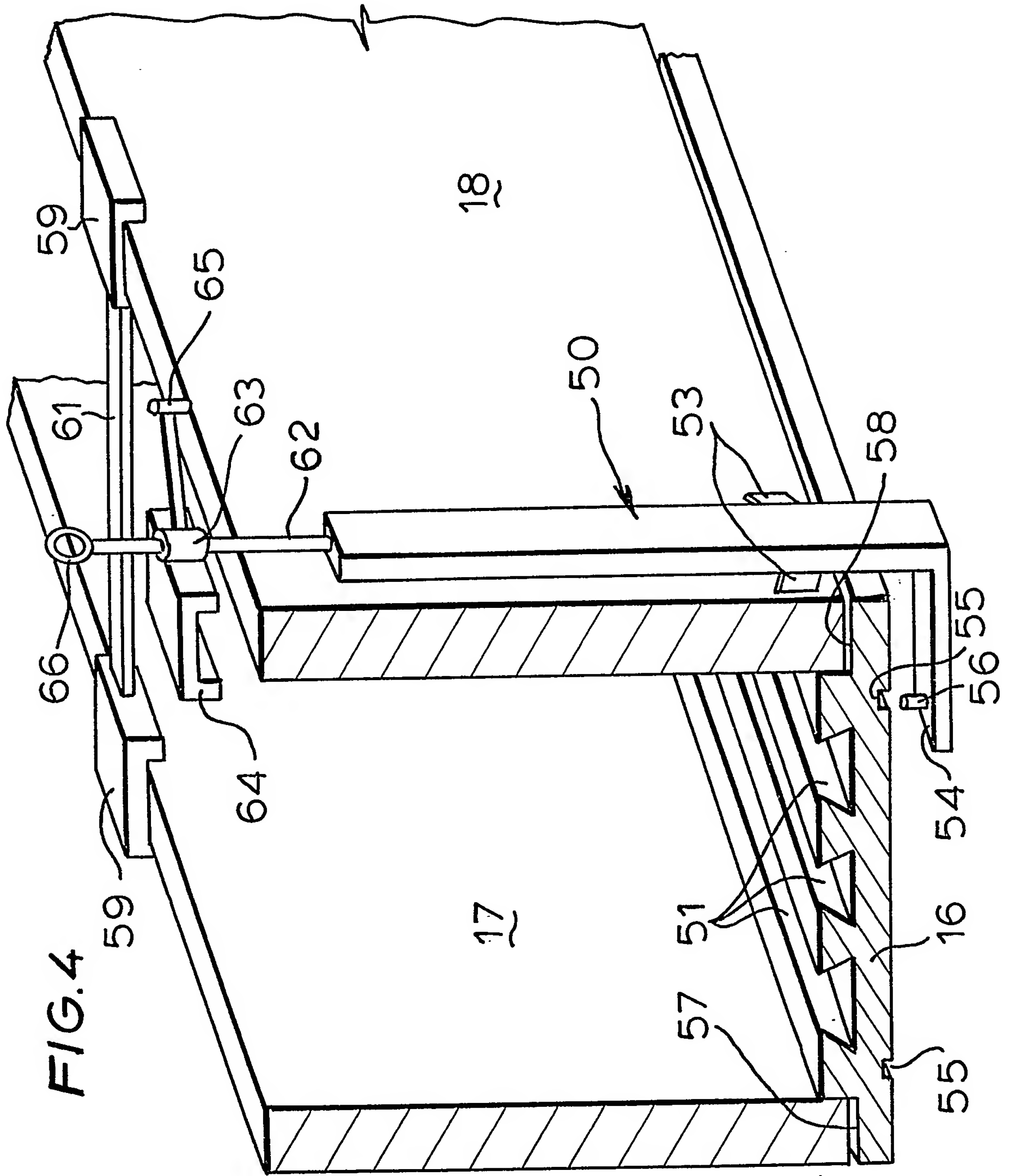


FIG. 6

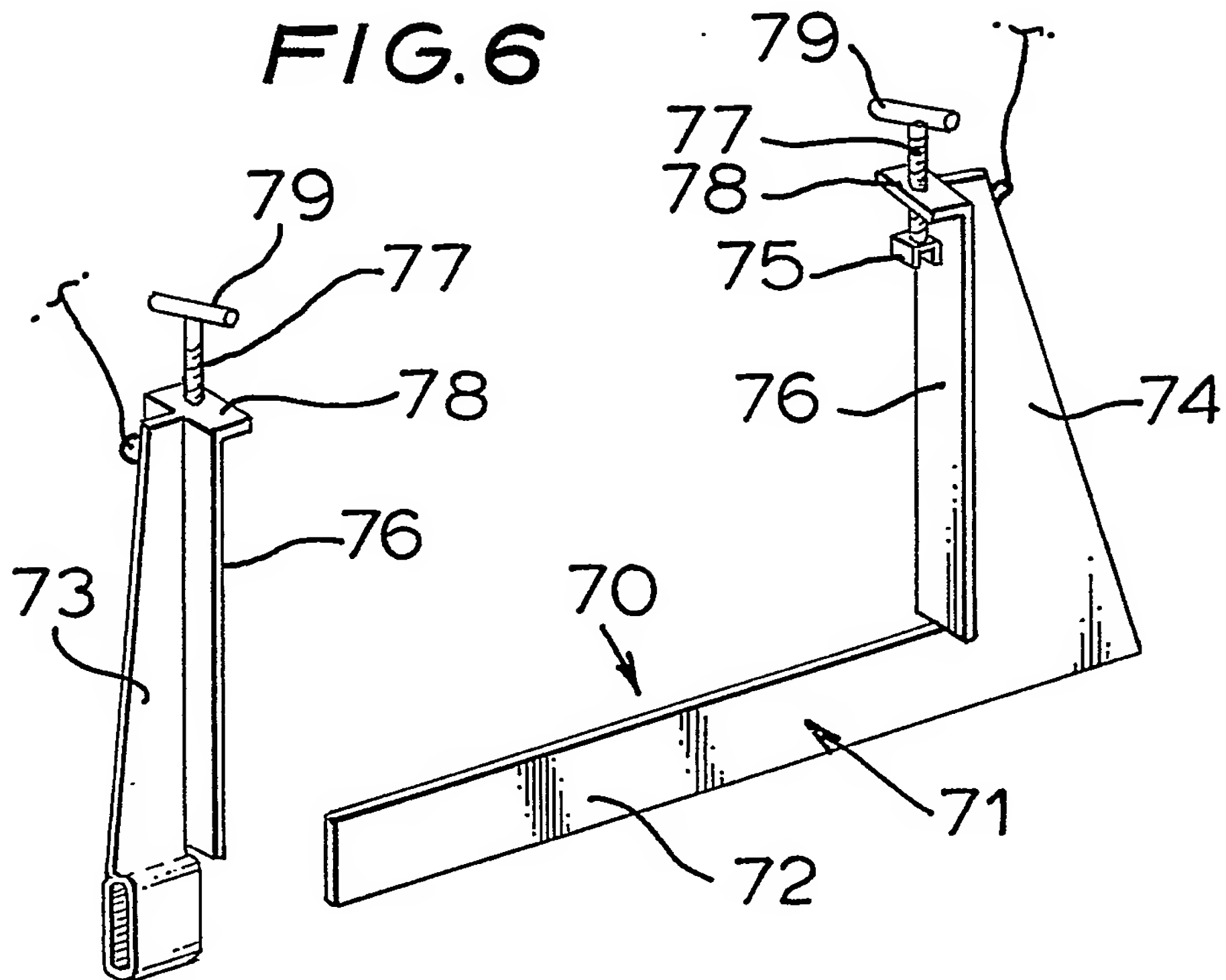
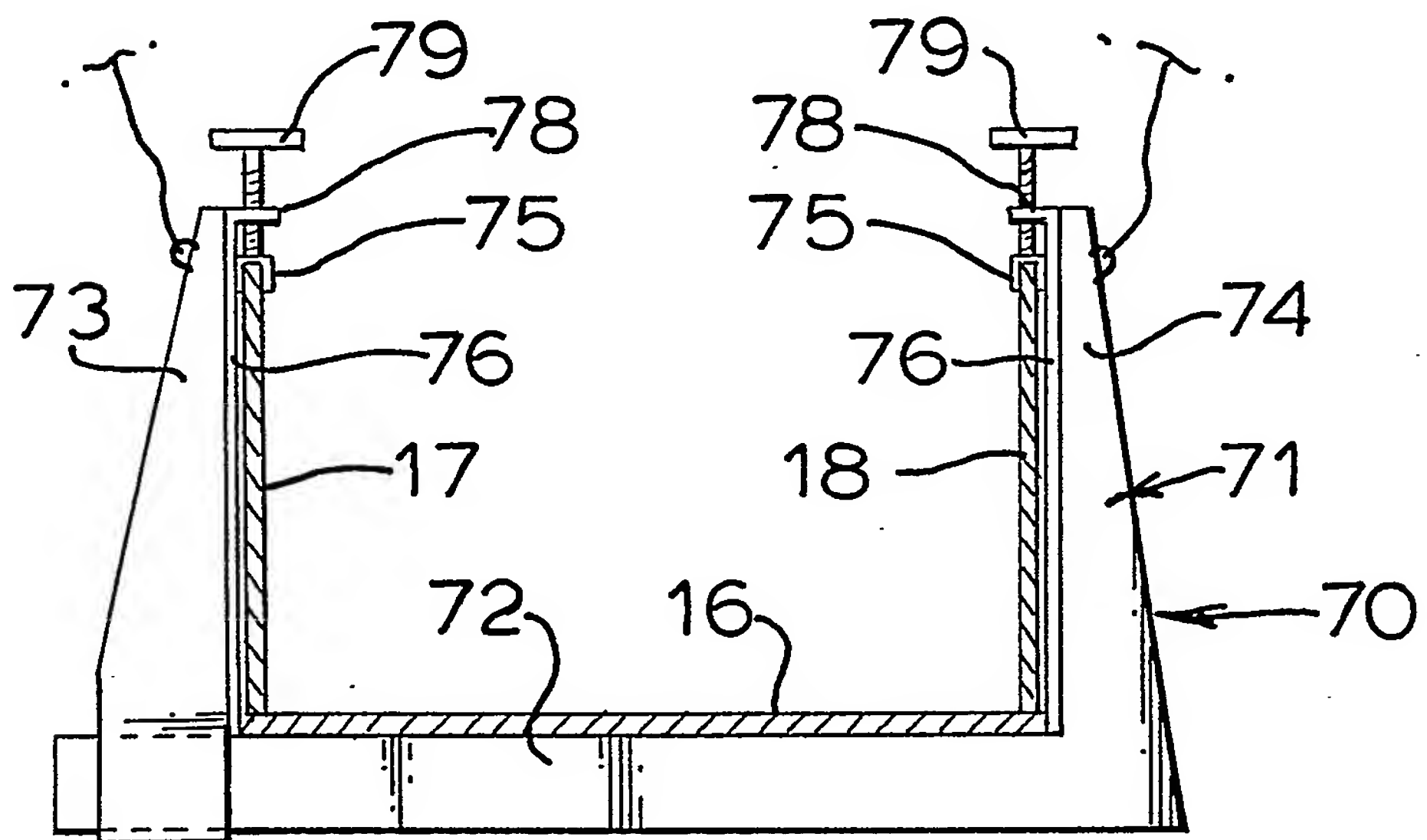


FIG. 5



IMPROVEMENTS IN OR RELATING TO BUILDING

This invention relates to building methods, to structures, particularly beam-supported structures (e.g. buildings, raised walkways and the like) built by such methods, and to apparatus for use in building methods.

The formwork apparatus conventionally used for constructing cast beams and the like is assembled by nailing wooden side panels permanently to a base panel and, e.g. at approximately 600mm centres, applying vertical struts (usually strutted and raked back to the ground) to ensure that the side panels do not bulge outwards when the concrete is poured in to the beam-like form provided by the formwork apparatus. The construction of formwork apparatus in this way is very time consuming. Furthermore, where the formwork apparatus is for the casting of a ground beam, it cannot be readily re-used for the construction of other or of further similar beams.

Moreover, where the ground beam is to support a structure upon soil liable to upward heave forces, it is usually necessary to provide heave relief means between the soil and the beam. One known form of such heave relief means comprises a rigid layer of fibre-board material which degrades or rots progressively as it takes up moisture from the soil and/or atmosphere (e.g. due to rain). The fibre-board panels in general use are heavy and often unsightly during their degradation. Moreover, prior to use they need to be stored in dry surroundings - a difficulty on most building sites.

Another known form of such heave relief means comprises a sheet of expanded polystyrene. However, due to their limited compressibility, such sheets usually have to occupy a considerable depth (or sheet thickness), with

consequential expense, and when compressed they in any event transmit uplift forces onto the beam.

5 It is considered desirable to overcome the above-mentioned and/or other disadvantages of the prior art.

According to a first aspect of this invention there is provided formwork apparatus for the casting of a beam, the apparatus comprising:

- 10 a first formwork panel to provide a bottom support for the beam during casting,
re-usable second and third formwork panels to provide lateral supports for the beam during casting, and
readily releasable compression imparting means having a
15 first, operable condition in which they serve to apply compressive forces between the first panel and the bottom edges of the second and third panels, such that said panels may form a self-supporting open-topped box, and a second, inoperable condition, in which such compressive forces are
20 released to permit removal (when the cast beam has set) of the second and third panels and their subsequent re-use.

It will be appreciated that following their removal, the second and third formwork panels can be re-used (with a
25 fresh first formwork panel) in formwork apparatus for the casting of another beam or of an extension to the first said beam.

Optionally the apparatus further comprises releasable
30 fastening means to interconnect said first panel to each of said second and third panels.

Advantageously the releasable fastening means is disconnectable from the said first panel such as to be wholly re-
35 usable in the casting of another beam.

Preferably the compression imparting means comprises an over-centring device to provide a quick-release mechanism.

5 Preferably the first formwork panel is formed of cement-bonded particle board. Advantageously the first panel has its upper surface provided with undercut openings (e.g. grooves of dovetail cross-section) to effect a keyed bond to the cement, concrete or other casting material.

10 Preferably, the side edges of the first panel are rebated to support, and provide lateral abutment for, the bottom edges of the second and third panels. The latter may, for example, be made wood.

15 Where the beam is to be cast in situ as a ground beam within a trench, the apparatus may additionally comprise means for suspending the formwork above the trench bottom.

20 Advantageously the suspension means comprises laterally extending members to overlie the sides of the trench.

According to a second aspect of this invention there is provided a method of constructing a beam using apparatus according to said first aspect of this invention.

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According to a third aspect of the present invention there is provided a method of building a structure upon soil liable to impart upon the structure upward forces due to heave of the soil, said method including the step of casting
30 a ground beam for the structure within a formwork for the beam located in a trench, said formwork being self-supporting and suspended such as to be spaced above the trench bottom. It will be appreciated that by such casting a void can be left beneath the ground beam to accomodate
35 ground movement due to heave forces.

Preferably the beam is cast in formwork apparatus according to said first aspect of this invention.

5 Preferably the formwork is supported in spaced relation to the trench bottom by laterally extending members overlying the sides of the trench.

10 According to a fourth aspect of this invention there is provided a beam built utilising apparatus according to said first aspect of this invention and/or utilising a method according to said second or said third aspect of this invention.

15 By way of non-limiting example, embodiments of this invention will now be described with reference to the accompanying drawings of which:

Figure 1 is a schematic transverse section through apparatus in one embodiment of the invention,

20 Figure 1a is a diagrammatic perspective view of a connector shown in Fig.1,

Figure 2 is a schematic illustration of quick-release compression imparting mechanism for use in a modification of the apparatus shown in Fig 1,

25 Figure 3 is a schematic illustration of an alternative compression imparting device to that shown in Fig 1,

Figure 4 is a schematic perspective view of apparatus in another embodiment of this invention,

30 Figure 5 is a schematic elevational view of apparatus in yet another embodiment of this invention and,

Figure 6 is a schematic perspective view, in separated relationship, of parts of the apparatus of Fig 5.

35 The apparatus 10 illustrated in Fig 1 is for casting a ground beam 15. The apparatus comprises formwork 11 suspended from suspension means 12 such that the formwork is

- spaced above the bottom of a trench 14 in which the cast ground beam 15 is to lie. The formwork 11 comprises a bottom panel 16 interconnected to two side panels 17, 18 by metal corner connectors 19 providing temporary fastenings.
- 5 The panels 16-18 may be each of wood or of cement-bonded particle board. Preferably the bottom panel 16 is of said cement-bonded particle board, and the two side panels 17, 18 are of wood.
- 10 Releasable compression imparting means 20 are provided on each side to hold the side panels 17, 18 and bottom panel 16 tightly together so that the apparatus forms a self-supporting, open-topped elongate box..
- 15 Each of the opposite metal corner connectors 19 of Fig 1 comprises a generally C- shaped channel 26 surmounted by a generally U-shaped channel 27, a web 24 depending from the C-shaped channel 26 and being substantially co-planar with its bight web and with the outermost side web of the U-
- 20 shaped channel 27. To assemble the formwork, the side selvedges of the bottom panel 16 are fitted into the C-shaped channels 26 of the two opposed connectors 19, and permanently attached thereto by nails hammered through the lower limb of the C into the underside of the wood bottom
- 25 panel 16. The bottom selvedges of the two side panels 17, 18 are then fitted into the U-shaped channels 27 of the opposed connectors 19. Two somewhat similar connectors 29, each shaped somewhat like the Greek letter pi, are provided on the upper selvedges of the two side panels 17, 18 and are
- 30 interconnected by a transversely extending turnbuckle device 28. The latter enables the two side panels 17, 18 to be positionally adjusted to be fully "square" at 90° to the bottom panel 16.
- 35 Each of the releasable compression imparting means 20 of Fig 1 comprises a threaded rod 30 that extends through the

outermost laterally projecting horizontal web 31 of a top connector 29, a tightening nut 32 threaded on the rod 30 being disposed above that web. The lower end of rod 30 has a hooked extension 34 to engage the web 24 of the bottom connector 19. By tightening the nuts 32 on the rods 30, connectors and panels of the formwork are urged into tight engagement with one another to form the formwork 10 as a self-supporting, open-topped, elongate casting box or trough for the casting of a ground beam. Accordingly, assembly of the box can be performed away from the intended casting location rather than in situ - which, for a ground beam, usually means within the trench 14 in which the cast ground beam is to lie.

For this latter purpose each compression imparting device 20 is provided with an upward extension 21 that has its upper free end bent over as a hook. This hook is to engage a transverse bar 22 that overlies the trench 14 and rests in horizontal disposition upon the ground to each side of the trench 14. This bar 22 and the hooked extensions 21 thus constitute suspension means 12 that suspend the self-supporting formwork box in spaced relation with respect to the trench bottom.

The releasable compression imparting device 20 of Fig 1 may be modified to the quick release device of Fig 2. This comprises an over-centering or toggle link mechanism having a lock release lever 42, which, on depression, causes the top connector 19 and bottom hooked end 30 to approach one another to effect locking together of a side panel 17 (18) and the bottom panel 16 of the formwork. Lifting of the lever 42 effects release of the interlocked relationship and permits device 40 to be disconnected from bottom connector 19. Once disconnected it can be removed from the trench for subsequent re-use (together with side panels 17, 18) in the

formation of another ground beam or an extended length of the same ground beam.

5 As shown in Fig 3, the lower hooked extension 34 of the releasable ~~bottom~~^{compression} imparting means 20 (or 40) may be provided with a pivotally attached foot plate 44 that (as compared with the point contact of Figs 1 and 2) provides increased surface-to-surface contact with the underside of the bottom panel 16.

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Alternatively, and as described below in respect of Fig 4, the underside of the bottom panel 16 can be provided with an elongate groove to receive the point of the lower hooked extension 34 of the means 20 or 40.

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It will be appreciated that with the embodiments of Figs 1 and 2 not only is the bottom panel 16 "lost", i.e. it remains in situ with the cast ground beam, but also the bottom connectors 19 (which are nailed to its bottom side) are likewise "lost". In the embodiment of Fig. 3, each bottom connector 49 has a shape somewhat like an inverted "h" to provided an inverted L-shaped arris 46 surmounted by a generally U-shaped channel 47. Instead of attachment to the bottom panel 16, by a nail through its lower limb, each connector 49 has the horizontal limb of the L (the bight wall of the U) provided integrally with one or more depending tines or tangs stamped out from an elongate triangular opening. The vertically depending limb of the inverted L is brought into abutment with the edge of the bottom panel 16, and the depending tines 45 then hammered down so that they enter the upper surface of panel 16. In this way the connector 49 can be firmly connected to the bottom panel 16 during casting and yet be subsequently removed therefrom. Alternatively, instead of the internal tines or tangs, the bight wall of the U may be simply apertured to permit nails to be hammered therethrough into

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the panel 16 from inbetween the webs of the U-shaped channel 47. With either arrangement, following release of the fastening means 20 (or 40) and their removal from the trench, the side panels 17,18 can be lifted out of the U-shaped channels 47 to permit removal of the connector 49 from off the bottom panel 16. If desired, the inside surfaces of panels 17,18 may be rebated at their bottom edges to facilitate post-casting removal of connectors 49.

10 In contrast however, in the embodiment of Figure 4 the connectors 19,49 are wholly omitted. Instead, the bottom edges of the (wood) side panels 17,18 are mounted directly upon rebated side edges 57, 58 of the bottom panel 16. The releasable compression imparting devices 50 of this
15 embodiment are similar to devices 40 of Fig 2 but are each provided, adjacent the lower hooked extension 54 with a laterally projecting resilient element 53 which, when the device 50 is in its operative condition, engages the respective side panel 17 or 18 in the manner of a leaf-spring and urges it laterally against the vertically
20 upstanding "step" of the rebate 57, 58. The extreme tip or point 56 of the lower hooked extension 54 of device 50 enters and engages in a groove 55 in the underside of the bottom panel 16 - the groove 55 extending parallel to the rebated side edges 57, 58 - this engagement contributing to
25 the reaction to the sideways force provided by resilient element 53.

The bottom panel 16 of this embodiment is a cement-bonded
30 particle board (e.g. as obtainable from C.P. Boards Ltd, Manor Yard, Gt. Shefford, Berks. RG16 7DZ) that is formed by compressing and curing a mixture of cement and wood chip particles. The board is machined (e.g. by routing) to provide not only the rebated side edges 57, 58 and the
35 underneath groove 55 referred to above, but also a plurality of dovetail-section grooves 51 in its upper surface. These

grooves 51 preferably also extend parallel to the rebated side edges 57, 58. The undercut grooves 51 serve to provide a keyed bonding between the bottom panel 16 and the casting material (e.g. concrete, cement or the like) of the intended beam.

The upper edges of the panels 17, 18 have clips 59 mounted thereon at longitudinally spaced intervals. Each pair of opposite clips 59 are interlinked by a longitudinally adjustable stay 61 to provide a selectively predetermined spacing between the clips 59. Adjustment of the stay 61 assists in holding the side panels 17, 18 upright, vertical and "square" to the bottom panel 16.

The releasable "clamp" or compression imparting device 50 of Fig 4 has an upwardly directed threaded rod 62 at its upper end on which is mounted a clip or clamp element 64 that fits over the upper edge of a side panel 17,18. The clip or clamp element 64 is connected by turnbuckle, worm gear or like mechanism 63 to a handle 65. Rotation of handle 65 in one direction causes element 55 to approach the hooked extension 54 and effect compression of the side and bottom panels (and compression of element 53), whereas rotation of handle 65 in the opposite direction effects release of these clamping and side forces.

As with the other embodiments described above, when the casting material has set, the quick-release toggle or overcentring mechanisms 52 of the devices 50 are operated to permit removal and recovery of the devices 50 and of the side panel 17, 18 for re-use in the assembly of formwork apparatus for another beam.

Although panel 16 is "lost", this is not of great consequence financially since cement-bonded particle board

is most inexpensive as compared to the fibre board heretofore usually used for heave relief (and which is now no longer required).

- 5 The use of cement-bonded particle board for panel 16 lends itself readily to the embodiments illustrated, by way of example, in Figs 7 to 10 of the accompanying drawings.

10 Fig 7 illustrates apparatus somewhat similar to that of the embodiment of Fig 3 but modified by omission of the connector 49. Also, the modified apparatus of Fig 7, like the embodiment of Fig 4, has a bottom panel 15 of cement-bonded particle board which is provided at its edges with longitudinally extending rebates 57 and, in its underside,
15 with two grooves 55. The releasable compression imparting means 80 (like the similar means 20 or 40 of Fig 3) is provided with a pivotally attached foot plate 84 that, as compared with the point contact provided by the embodiments of Figs 1 and 2, provides increased surface-to-surface
20 frictional contact with the underside of bottom panel 16. Further, to provide a keyed engagement additional to such frictional contact, the foot plate 84 is provided with an upstanding lug 85 to engage in the adjacent groove 55.

- 25 The compression imparting means 80 is also provided with a laterally extending stub 83 that may be rigid or resilient and is to engage the associated side panel 17 (or 18) and urge it into lateral engagement of the associated edge rebate 57 of the bottom panel 16.

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The alternative embodiment illustrated schematically in Fig 8 (as that of Figs 4 and 7) has a bottom panel 16 of cement-bonded particle board provided with rebates 57 at its side edges and with grooves 55 in its underside, the lower edges
35 of the side panels 17, 18 fitting into these rebates 57. However, in the Fig 8 construction, such interfitting is of

a keyed nature and is provided by a bead 88 depending from the lower edge of the side panel 17,18 and engaging in a groove 86 formed in the horizontal step of the associated rebate 57.

5

With such an arrangement, the releasable compression imparting means 90 can be of greatly simplified clip-like form and produced from a length of resilient metal strip or wire. As shown in unstressed condition in Fig 10, the clip-like means 90 has a generally triangular shape formed by two adjoining main limbs 91,93 that are integral with one another and, when unstressed, are at an acute angle to one another. The free ends of limbs 91,93 are respectively integral with associated short limbs 92,94 that are directed generally towards one another. In use, the clip-like means 90 is stressed for connection, firstly, to the bottom panel 16 by insertion of limb 92 into a groove 95 and, secondly, to an associated side panel 17,18 by insertion of the opposite short limb 94 into a groove 96 provided in the outer face of that associated side panel 17,18. In this inserted condition, the clip-like means 90 is stressed and serves to interconnect the bottom panel 16 to the associated side panel 17,18 firmly but in a readily releasable manner.

25 It will be apparent that the embodiment of Fig 8 need not be restricted to arrangements in which the bottom panel has rebated side edges. Indeed, as illustrated in the modification of Fig 9, the construction can just have the grooves 86 in the upper surface of the bottom panel 16 adjacent its non-rebated side edges, and with the same beads 88 depending from the lower edges of the side panels 17, 18. The keyed connection provided by grooves 86 and beads 88 is held fast by a plurality of the selfsame clip-like compression-force imparting means 90 that, at spaced apart intervals, are interfitted into the grooves 95,96 thereby to interconnect the bottom and side panels 16 and 17,18.

It will be appreciated that the various embodiments of apparatus described above can be used for casting beams other than ground-beams, e.g. for ceiling beams and/or other raised beams that are in use supported on piles or walls.

5 During casting however, the apparatus may be supported (by pillars, struts, walls or the like) or, may be suspended (by transverse bars such as 22 of Fig 1 or eyelets 66 of Fig 4) to provide a void beneath the formwork over the majority of its length. Other embodiments and modifications (and

10 interchanging of devices or parts between the various embodiments) will be readily apparent to the skilled reader, all such being in accord with the scope and principles of this invention.

15 For example, in addition to (or possibly instead of) the quick release compression imparting devices 50, a more rigid bracing and holding device 70 (Figs 5, 6) may be provided at wider intervals along the length of the self-supporting, open-topped, elongate casting box. The panels 16, 17 and 18

20 are of the form described above (preferably in relation to Fig 4) and each of the devices 70 comprises a generally L-shaped metal bracket 71 onto the (lower) horizontal limb 72 of which an upstanding metal bracket 73 is longitudinally slidable, in a vertical attitude, parallel to the vertical

25 limb 74 of the L-shaped bracket 61. The limbs 73, 74 have a horizontal cross-section that is generally T-shaped, the transverse cross-web 76 of the T being innermost and in use in surfacial engagement of the outer vertical face of the respective side panel 17, 18. An inwardly directed flange

30 78 at the top of each limb 73, 74 is provided with a threaded hole through which a threaded rod 77 extends, the top of rod 77 being fast with a transverse bar-like handle 79 and the bottom of rod 77 being pivotably connected to a clip 75 of inverted U-section.

35 In initial assembly, the bottom panel 16 is lain across two longitudinally spaced apart brackets 71, a side panel 18 is

positioned against the cross-web 76 of limb 74, bracket 73 is connected to limb 72 of bracket 71 whilst the side panel 17 is positioned against its cross-web 76, and the handles 79 are rotated to screw down the clips 75 onto the top edges of the side panels 17, 18 and keep them upright in vertical planes "square" to and compressed downwardly upon the bottom panel 16.

CLAIMS

1. Formwork apparatus for the casting of a beam, the apparatus comprising:

a first formwork panel to provide a bottom support for the beam during casting,

re-usable second and third formwork panels to provide lateral supports for the beam during casting, and

readily releasable compression imparting means having a first, operable condition in which they serve to apply compressive forces between the first panel and the bottom edges of the second and third panels, such that said panels may form a self-supporting open-topped box, and a second, inoperable condition, in which such compressive forces are released to permit removal of the second and third panels (when the cast beam has set) and their subsequent re-use.

2. Apparatus according to Claim 1 and further comprising releasable fastening means to interconnect said first panel to each of said second and third panels.

3. Apparatus according Claim 2, wherein the releasable fastening means is disconnectable from the said first panel such as to be wholly re-usable in the casting of another ground beam.

4. Apparatus according to any preceding Claim, wherein the compression imparting means comprises an over-centring device to provide a quick-release mechanism.

5. Apparatus according to any one of the preceding Claims and for use in casting a ground beam within a trench, said apparatus additionally comprising means for suspending the formwork above the trench bottom.

6. Apparatus for use in the casting of a ground beam, said apparatus comprising:

a first formwork panel to provide a bottom support for the beam during casting,

re-usable second and third formwork panels to provide lateral supports for the beam during casting,

releasable fastening means to interconnect said first panel to each of said second and third panels in a manner permitting release and removal of the second and third panels when the ground beam has set, and

means for suspending the formwork in a trench above the trench bottom.

7. Apparatus according to Claim 5 or Claim 6, wherein the suspension means comprises laterally extending members to overlie the sides of the trench.

8. Apparatus according to any preceding Claim wherein the first formwork panel comprises a cement bonded particle board.

9. Apparatus according to any preceding Claim wherein the first formwork panel has its upper surface provided with undercut openings to effect a keyed bond to the casting material.

10. Apparatus according to Claim 9 wherein said undercut openings comprises grooves of dovetail cross-section.

11. Apparatus according to any preceding Claim wherein the edges of said first formwork panel are rebated to support, and provide lateral abutment for, the bottom edges of the second and third formwork panels.

12. Apparatus substantially as herein described with reference to and/or as illustrated in the accompanying drawings.

13. A method of constructing a beam using apparatus according to any one of Claims 1 to 12.

14. A method of building a structure upon soil liable to impart upon the structure upward forces due to heave of the soil, said method including the step of casting a ground beam for the structure within a formwork for the beam located in a trench, said formwork being self-supporting and suspended such as to be spaced above the trench bottom.

15. A method according to Claim 14, wherein the formwork is supported in spaced relation to the trench bottom by laterally extending members overlying the sides of the trenches.

16. A method according to Claim 14 and substantially as herein described with reference to the accompanying drawings.

17. A beam built utilising apparatus according to any one of Claims 1 to 12 and/or utilising a method according to any one of Claims 13 to 16.

Patents Act 1977
 Examiner's report to the Comptroller under
 Section 17 (The Search Report)

Application number
 9102947.0

Relevant Technical fields

- (i) UK CI (Edition K) E15
 (ii) Int CL (Edition 5) E04G

Search Examiner

A. H MITCHELL

Databases (see over)

- (i) UK Patent Office
 (ii) ONLINE DATABASE: WPI

Date of Search

17 JUNE 1992

Documents considered relevant following a search in respect of claims

1-5

Category (see over)	Identity of document and relevant passages		Relevant to claim(s)
X	GB 1080962	(G.K.N) see Figure 1 panels 18 are releasably mounted	1-3
X	GB 914317	(RAPID) see Figure 1 Panel 4 is held in compression	1-3
X	GB 820326	(KWIIFORM) see Figure 2	1-3

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

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